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Proceedings of the regional advisory peer review meeting of the Assessment of Atlantic Cod (*Gadus morhua*) of the southern Gulf of St. Lawrence (NAFO Div. 4T-4Vn (Nov. – April)) to 2014

March 12, 2015
Moncton, NB

Chairperson: Marc Lanteigne
Rapporteur: Venitia Joseph

Fisheries and Oceans Canada
343 University Ave
Moncton, NB, E1C 9B6

March 2016

Canada

Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

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SUMMARY

A regional advisory process meeting was held March 12, 2015 in Moncton (NB) to conduct a science peer review of the assessment of stock status of Atlantic cod (*Gadus morhua*) of the southern Gulf of St. Lawrence (NAFO Div. 4T-4Vn (Nov. – April)) to 2014. The science review was conducted in response to a request for advice from DFO Fisheries and Aquaculture Management (FAM) for a Total Allowable Catch (TAC) decision for May 2015 to May 2019. Participants at the science review included science staff and resource management of DFO Gulf Region, from DFO Maritimes Region, and the fishing industry. The terms of reference for the meeting were addressed. The products of the meeting include a science advisory report and a supporting research document. This proceeding report summarizes the major points of discussion, conclusions, and recommendations from the science peer review meeting.

SOMMAIRE

Une réunion du processus consultatif régional a eu lieu à Moncton (Nouveau-Brunswick) le 12 mars 2015 afin d'entreprendre un examen scientifique par les pairs de l'évaluation de l'état du stock de morue franche (*Gadus morhua*) du sud du golfe du Saint-Laurent (Div. de l'OPANO 4T-4Vn [nov. – avril]) jusqu'en 2014. L'examen scientifique a été effectué en réponse aux demandes de consultation formulées par Gestion des pêches et de l'aquaculture (GPA) du MPO pour une décision de total autorisé des captures (TAC) entre mai 2015 et mai 2019. Les participants à l'examen scientifique comprenaient le personnel des sciences et de la gestion des ressources de la région du Golfe du MPO, de la région des Maritimes du MPO et de l'industrie de la pêche. Les cadres de référence de la réunion ont été traités. Les résultats de la réunion comprennent un avis scientifique et un document de recherche à l'appui. Ce compte rendu résume les principaux points de discussion, les conclusions et les recommandations de la réunion d'examen scientifique par les pairs.

INTRODUCTION

A regional science advisory process peer review meeting of the fishery and status of the Atlantic Cod (*Gadus morhua*) of the southern Gulf of St. Lawrence (NAFO Div. 4T-4Vn (Nov. – April)) to 2014 was held in Moncton (NB) on March 12, 2015.

The terms of reference for the science review were developed jointly by DFO Fisheries and Aquaculture Management and DFO Science Branch, Gulf Region (Appendix 1).

The meeting began at 10:00 AM, Thursday March 12, 2015. The chair (M. Lanteigne) reviewed the meeting room arrangements and indicated that simultaneous translation services were provided.

The chair reviewed the rules of exchange for the meeting, reminding participants that the meeting was a science review and not a consultation. As well, everyone at the meeting had equal standing as participants as there was no observer status at the meeting. Table microphones were provided to ensure good communication during the meeting, to allow for simultaneous translation of the presentations and discussions and as such, exchanges would have to take place one at a time and, if required, through order of the chair. Finally, the objective was to achieve consensus on the appropriateness of the assessment documents and that for the purposes of the science review, consensus was taken as an absence of opposition.

The list of participants is provided in Appendix 2.

The chair reviewed the terms of reference for the meeting. The draft agenda was reviewed and accepted (Appendix 3).

Rapporteur duties were assigned to Venitia Joseph, DFO Science Gulf Region.

There was one working paper to be reviewed which had been circulated to confirmed meeting participants on March 9, 2015.

PRESENTATION OF WORKING PAPER

The working paper was presented by Doug Swain, DFO Science Gulf Region.

The presentation was structured according to main topics in the working paper and comments and discussion were considered after each topic presentation.

FISHERY

A point was noted about the lack of complete information coming from fishery data (discarded by-catch, and illegal catch which are unreported) which does not reflect the complete fisheries data. However, even though this is true, the important point here is that stock status is based on fishery-independent surveys. The fishery data affect estimates of fishing mortality, but mortality due to unreported catch is accounted for in the assessment model as a component of "natural" mortality, which is also estimated by the model.

INDICES OF ABUNDANCE

DFO bottom-trawl survey (RV survey)

This research vessel (RV) survey of the southern Gulf of St. Lawrence, conducted each September since 1971, is the primary source of information for abundance indices and biological characteristics of cod. Main points from the survey are:

- Catch rates in the RV survey indicate that commercial-sized cod are at record-low levels of abundance and biomass and have declined severely from the already low levels observed in the late 1990s and early 2000s.
- Striking shifts in cod distribution are evident over the long term noted primarily as a shift out of inshore waters.
- Progressive shift in cod distribution out of shallow inshore areas throughout the 1990s and 2000s is in addition to a large decline in abundance, length distributions of cod caught in the RV survey, indicate a disproportionate loss of large individuals in recent years.
- Mean length and weight at age declined from the late 1970s to the mid to late 1980s. Size-at-age has remained stable at a low level since then.

Mobile sentinel survey

The mobile sentinel survey, conducted each August since 2003, is a stratified-random bottom trawl survey using the same stratification scheme as the RV survey. Each year the survey is conducted by four commercial fishing vessels, each using the same standardized otter trawl (the 300 Star Balloon) and standardized fishing protocols.

- Abundance and biomass indices from this survey have also declined severely since 2003.
- Catches in the sentinel survey show the same shift out of shallow inshore areas that is observed in the RV survey.
- No trends in length or weight-at-age are evident over the 2003-2014 time series of the mobile sentinel survey.

Longline sentinel program

Sentinel longlines have been fished with consistent protocols since 1996. Each participating vessel is required to fish at two traditional fishing areas selected by the participating fishermen (or their association). There are currently 36 fishing sites in the sentinel longline program, distributed throughout inshore areas of the southern Gulf.

- Standardized catch rates declined steadily between 2004 and 2011 (Fig. 25). Catch rates remained near this low level in 2012- 2014, averaging 26% of the 1995-2004 level. Declines in the sentinel longline catch rates are substantially greater for older ages.

DISCUSSION

There was a reoccurring point of discussion throughout the meeting around the role of seal predation on cod populations. It was noted that the fish have moved away from inshore to deeper water not because of changes in food (forage species) distribution but rather due to seal predation. This pattern was determined by the index of risk of predation by seals which is obtained through satellite tagged seals and aerial surveys of haul-out sites.

The fishermen have also noticed that cod in deeper waters are in better condition (based on liver) than inshore cod.

There was a general frustration by the fish harvesters around the lack of a seal cull to address the issue of seal predation on cod.

There was also questions regarding the overall fecundity of the spawning biomass (ie. do bigger cod have disproportionately more eggs / kg and eggs of higher quality). Currently, no information is collected during the DFO surveys on the quality and quality of eggs. The rate of

recruitment (recruits per unit of spawner biomass) is not considered low, however recruitment (in numbers of juveniles) is low due to low spawner biomass.

POPULATION MODELS

Models

Two types age-structured population models were fit to the sGSL cod data from the DFO surveys and fisheries: Virtual Population Analysis (VPA) and Statistical Catch at Age (SCA). Models extended from 1950 to 2014 and from age 2 to ages 12+. Although there were differences between the model, both models provided a good fit to the observed trends in abundance by age group and led to similar conclusions about stock status.

Projections

Using the SCA model, the population was projected forward four years (Jan 1 2015 to Jan. 1 2019). With no fishery catch, projected spawning stock biomass (SSB) initially increases due to the strong incoming recruitment, and then declines as these fish suffer high natural mortality. Based on the projection, there is no chance that SSB equaled or will equal the Limit Reference Point (LRP) at the start of 2015-2017. The probability of SSB equaling or exceeding the LRP increases to 0.1% at the start of 2019. The probability that SSB will decline between 2015 and 2019 is 79%, meaning the stock will remain in the critical zone of the Precautionary Approach Framework. By-catch of 300 t (the current by-catch limit) has a negligible effect on the projected trajectory.

Discussion

There was a general sense of disappointment among the fish harvesters on the lack of a directed fishery for cod, and questions circled around any possibilities of having a minimal fishery for cod without affecting the current biomass.

The participants from the fishing industry stated that although they have also noticed the declines in cod abundance for the last 6-7 years, recently as of last year, they have noticed an increase in cod numbers and the fish also seem healthier in certain areas. This was explained by science as a difference in the scale of observations. Observations by fishermen are on a finer scale than that done by science which looks the population at a larger scale (ie. NAFO 4T). The RV and sentinel mobile surveys have demonstrated a striking change in the distribution of cod in recent years, with cod shifting from inshore to offshore waters. Fish harvesters noticing a recent improvement are those fishing in these offshore areas. The message was clear from science research that the cod population trajectory is on a decline and what is driving the lack of recovery of cod is unusually high natural mortality of adult cod. The weight of evidence suggests that predation by grey seals is a major component of this elevated natural mortality.

There was discussion on why there is an increase in cod abundance in 2016 and then a projected decline in the population. It was explained that for small cod (ages 2-4) natural mortality has not changed, but after age 4 , the cod experience unusually high natural mortality due at least in part to seal predation so that you see bursts of recruitment in small cod and then a decline as they reach ages 5+. So the increase in 2016 is due to the recruitment of the relatively strong 2011 year-class and the subsequent decline reflects the rapid loss of these fish at older ages due to elevated natural mortality.

The role of environmental factors such as water temperature on the cod recovery was brought up in discussions but in this case the evidence points to the high rates of predation which can be seen in population patterns of other fish species (hake, thorny skate) as well.

Some fish harvesters strongly pushed to allow for them to gather some information on cod because other fisheries have by-catch of cod and felt that these numbers were not been accurately reported. There was a general agreement that methods for better accounting of by-catch was needed. There was also concern from fishers that if they did not have projects to partner with science to collect data, in the absence of a fishery, they would lose the expertise on the water in the future. The fishers were interested in knowing whether a minimal fishery for 1-2 years would add value for collecting science data. However, all surveys indicate the stock is at a low level and any directed fishery will increase the decline in the cod population.

THE LIMIT REFERENCE POINT

The limit reference point (LRP) for this stock was established in 2003 based on the model-based stock-recruit relationship as well as the minimum biomass from which the stock had previously recovered. In the 2003 analyses, it was assumed that the maturity schedule had been constant since 1950. Since then, it has been determined that there have been large changes in age at maturation since 1950 and these changes have been incorporated into the calculation of spawning stock biomass (SSB) in the models used here. There also have been major revisions in the estimation of time trends in natural mortality. These changes have important impacts on the estimates of SSB obtained from population models. Because of these model changes, it is recommended that the reference point calculations for this stock be revised for the next assessment.

Based on the current models, the LRP would be greater than 80,000 t. However, for this assessment, this is not an issue because SSB is estimated to be less than 40% of the LRP and, based on the projections, there is no chance that SSB will reach the LRP over the next five years.

CAUSES FOR LACK OF RECOVERY

The extremely high natural mortality (M) of cod five-years and older is the reason for the lack of recovery (and continued decline) of this stock. If M were at a normal level (i.e., 0.2, the estimated level in the 1950s and 1960s) and other components of productivity were at their current levels, this stock would recover quickly at current levels of fishing mortality.

Previous publications have examined a suite of hypotheses for the causes of this elevated mortality, namely unreported catch (i.e., some of the increased mortality is unknown fishing mortality, not natural mortality), emigration (i.e., older fish are leaving the ecosystem, not dying), or increased natural mortality due to disease, contaminants, poor fish condition as a result of harsh environmental conditions, life-history change (early maturation, early senescence), heavy parasite loads, or increased predation mortality. The weight of evidence most strongly supported the hypothesis that predation by grey seals was a major cause of the increases in natural mortality and recovery of cod in the southern Gulf is unlikely even in the absence of fishing, unless the abundance of grey seals declines.

INDICATOR OF STOCK STATUS

A 3 year average for RV survey biomass of commercial sized cod (≥ 42cm) is proposed as the indicator of stock status between full stock assessments during the four year multi-year management plan. A 3-year average was chosen because it is more stable (less prone to fluctuation due to observation error) than an annual value. The indicator would be compared to the limit reference point (LRP) to characterize changes in stock status. The LRP would be adjusted to the RV survey scale, based on the estimated catchability to the survey.

Discussion

The question of what changes in RV biomass indicator would trigger an early assessment during the 4- year science assessment period was discussed (i.e., if the indicator decreases then nothing can be done but if there is an increase, then how much of an increase would trigger a reassessment to explore a potential fishery). It was concluded that a re-assessment would be triggered if the 3-yr moving average exceeded the scaled LRP. Consensus was reached that the biomass indicator be updated and presented to the management advisory committee which meets every two years (next meeting in Jan 2017).

RECOMMENDATIONS

- Due to improvements in models for estimating population abundance and dynamics, it is recommended that the reference points for the Precautionary Approach be re-examined and presented at the next science review in 2019.
- The interim year indicator and an evaluation of whether a re-assessment would be conducted earlier than the 4-year assessment cycle will be prepared after the 2016 survey year.

ADVISORY REPORT AND MEETING PRODUCTS

A summary of key points for the draft advisory report was completed after the meeting. The advisory report was drafted after the meeting and finalized in November 2015.

The working paper should be upgraded to a research document.

The peer review committee completed the review of the working paper and reached consensus on the summary bullets at the close of business on March 12. Consequently, the group did not convene on March 13 as originally scheduled.

APPENDICES

APPENDIX 1. TERMS OF REFERENCE

Assessment of Atlantic Cod (*Gadus morhua*) of the southern Gulf of St. Lawrence (NAFODiv. 4T-4Vn (Nov. – April))

Regional Peer Review – Gulf Region

March 12, 2015
Moncton, New Brunswick

Chairperson: Marc Lanteigne (DFO Gulf Region)

Context

The last full assessment of the Atlantic cod stock in the southern Gulf of St. Lawrence (*Gadus morhua*; NAFO Div. 4T-4Vn Nov-April) was completed in February 2009 (DFO 2009). In addition, a Recovery Potential Assessment (RPA) was conducted in February 2011 (DFO 2011). Both these analyses led to the conclusion that adult biomass in this stock was at the lowest level observed in the 60-year record and well below the limit reference point for this stock, the level below which the stock is considered to have suffered serious harm to its productivity. Research Vessel and sentinel biomass indices for pre-commercial and commercial sizes of Atlantic cod in recent years indicate that there has been no improvement in biomass since the last assessment and the commercial biomass remains at record low level (DFO 2014).

The directed fishery for southern Gulf cod (NAFO Div. 4T-4Vn Nov-April) was closed in 1993-1997, 2003, and has remained closed since 2009. A total allowable catch of 300 t has been provided to cover by-catch in other groundfish fisheries, a limited recreational fishery, for scientific purposes, and to cover negotiated Aboriginal food, social and ceremonial agreements. In support of DFO Ecosystems and Fisheries Management multi-year management approach and request for advice for a TAC decision for May 2015 to May 2019 for the southern Gulf of St. Lawrence Atlantic Cod, DFO Science Branch Gulf Region will undertake a peer review of the stock status of Atlantic Cod and develop management advice for the fishery on this stock.

Objectives

To develop science advice in support of the multi-year TAC decision for Atlantic Cod (NAFO Div. 4T-4Vn (Nov-April)) the following items will be considered:

- Amounts, age, and size structure of the catch of Atlantic cod from the southern Gulf of St. Lawrence fisheries to 2014
- Indices of abundance of Atlantic Cod from the research vessel and sentinel surveys
- Best estimates from a population model of the spawning stock biomass, recruitment, recruitment rates, and mortality rates (fishing, natural) to 2014
- Status of the stock relative to defined biological reference points
- Population trajectories under current productivity (growth, recruitment, natural mortality) rates and assuming an annual 300 t by-catch of Atlantic Cod, and probabilities of the spawning stock biomass being in the critical zone, the cautious zone, or the healthy zone of the Precautionary Approach framework for 2015 to 2019.
- Identify indicators which would be used to characterize stock status in the intervening years of the five-year assessment and management cycle and the changes in the indicators or in the characteristics of the fisheries that catch cod incidentally which would trigger a re-assessment earlier than the scheduled five-year assessment cycle.

- Identification of uncertainties and knowledge gaps

Expected publications

- CSAS Science Advisory Report
- CSAS Proceedings
- CSAS Research Document(s)

Participation

- DFO Science Branch
- Other DFO Sectors
- Provinces
- External experts (to DFO)
- Fishing industry
- Aboriginal peoples

References

DFO. 2009. Assessment of Cod in the southern Gulf of St. Lawrence. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2009/007.

DFO. 2011. Recovery Potential Assessment for the Laurentian South Designatable Unit of Atlantic Cod (*Gadus morhua*). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2011/020.

DFO. 2014. Updated indices of abundance to 2013 for stocks of six groundfish species assessed by DFO Gulf Region. DFO Can. Sci. Advis. Sec. Sci. Resp. 2014/020.

APPENDIX 2: LIST OF PARTICIPANTS

Name	Affiliation
Ward, Celia	Association des citoyens de la Côte de Sable
Anderson, Paul	MEI Water Department Groundwater Association
Bailey, Diana	DFO Science Gulf Region
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LeBlanc, Carole	DFO Species at Risk Gulf Region
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Savoy, Marcel	Association des riverains de Caraquet
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Stevens, Patrick	Association des riverains de Caraquet
Swain, Doug	DFO Science Gulf Region
Thibeault, Charlotte	DFO Resource Management Quebec Region
Wang, Yanjun	DFO Science Maritimes Region

APPENDIX 3: MEETING AGENDA

Science Advisory Process Southern Gulf of St. Lawrence Atlantic Cod	
Thursday, March 12, 2015	**Time**
Meeting room open, participants arrive and set-up for meeting	09:30 – 10:00 am
Opening remarks and review of agenda	10:00 – 10:15 am
Fishery and survey data Population modeling	10:15 am – 12:00 pm
Lunch (not provided)	12:00 – 1:00 pm
Population modeling (continued) Population trajectories Identification of indicators and triggers for re-assessment for interim year updates	1:00 – 4:30 pm
Health Break	3:00 – 3:15 pm
Friday March 13, 2015	
Meeting room open, participants arrive and set-up for meeting	8:15 – 8:30 am
Catch up from previous day (*if required*) Review of draft Science Advisory Report 4T Cod	8:30 am – 12:30 pm
Health Break	10:00 – 10:15 am
End of meeting	12:30 – 1:00 pm